Interrogating the role of hydrogel electrical and physical properties on neural cell behavior

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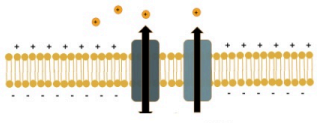
Introduction



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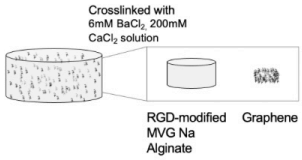
Methods

Experimental Design:



Mechanical Characterization

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Results

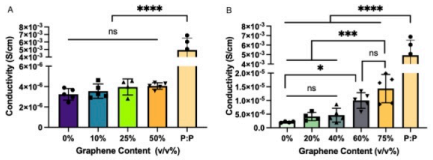


Figure 1. Electrical characterization of graphene, RGD-modified Na alginate hydrogels. Conductivity of hydrogels containing increasing graphene concentrations of 0 to 60 v/v% graphene **(A)** and 0 to 75 v/v% graphene **(B)**. P:P, pure PEDOT:PSS, is the positive control. Data are mean ∓ SD; n=4-5.

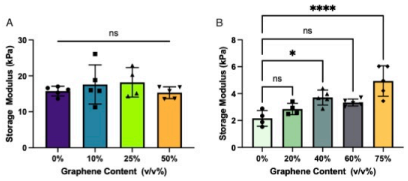
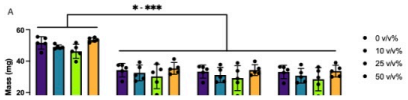


Figure 2. Mechanical characterization of graphene, RGD-modified Na alginate hydrogels. Storage modulus of hydrogels containing increasing graphene concentrations of 0 to 60 v/v% graphene **(A)** and 0 to 75 v/v% graphene **(B)**. Data are mean ∓ SD; n=4-5.



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Conclusion

- The maximum concentration of graphene for gelation is 75 v/v%.
- An increase in graphene concentration can lead to an increase in conductivity.
- Storage modulus remains similar for most graphene concentration groups.
- Degradation rate of graphene alginate hydrogels declines from day 5

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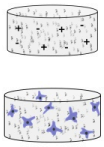
Future work

The effect of hydrogel conductivity on:

- Hydrogel surface charge.
- PC12 cell adhesion.
- Cell viability and metabolic activity.
- Neurite extension and neuronal gene expression.



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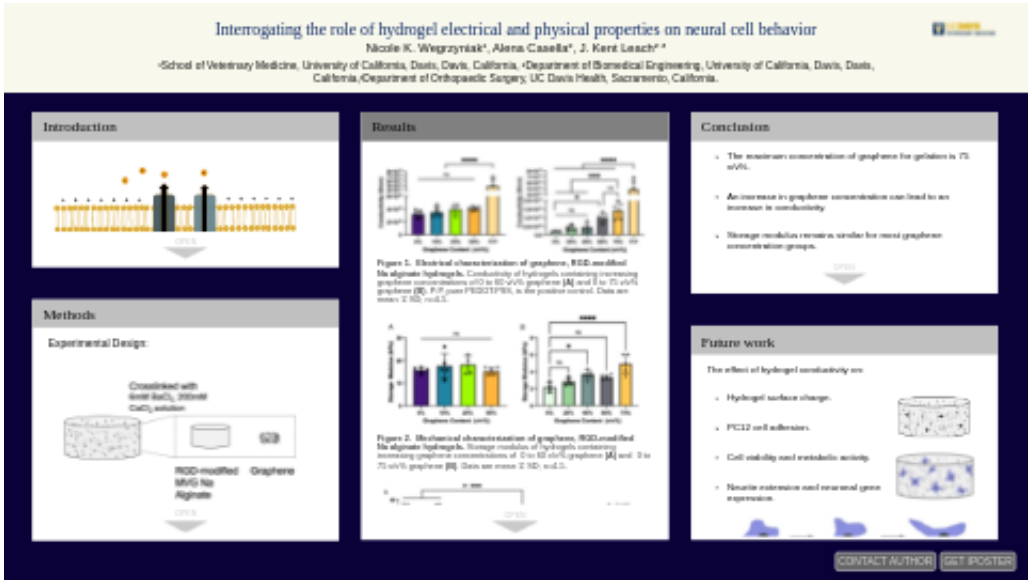

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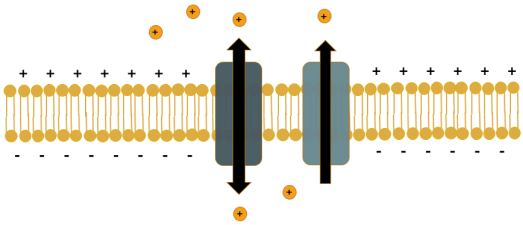
PRESENTED AT:

AAVMC American Association of Veterinary Medical Colleges

NVSS National Veterinary Scholars Symposium

INTRODUCTION



- Nearly every tissue in the body is innervated and influenced by cellular bioelectricity, which is crucial for proper tissue behavior, homeostasis, and healing, yet this aspect has received limited attention in tissue engineering.

- Conductive biomaterials direct electroactive cell behavior and differentiation.

- Graphene is an electron conductor commonly used in tissue engineering to support nerve activity while alginate is commonly used as a cell transplantation vehicle due to its tunability and biocompatibility.

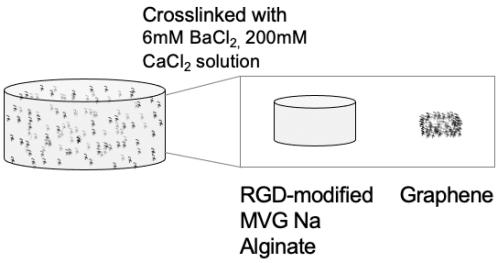
- The interplay between material electrical and physical properties is poorly understood and is critical for improving biomaterial design for clinical translation.

Hypothesis:

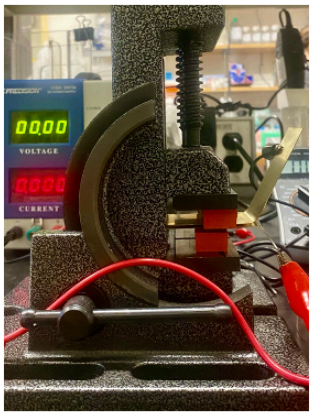
The interplay of hydrogel electrical and physical properties, including conductivity, storage modulus, and degradation, influences cell adhesion and viability and promotes neural cell morphology and behavior.

METHODS

Experimental Design:



Mechanical Characterization

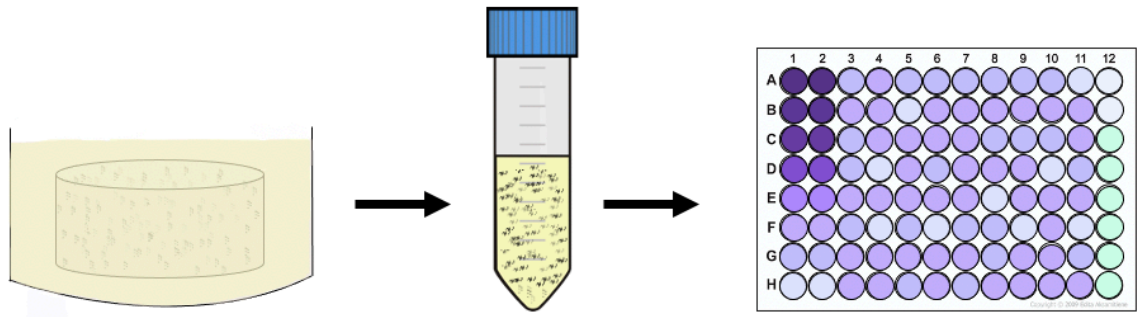


Conductivity

Storage Modulus

Degradation

Protein Adsorption

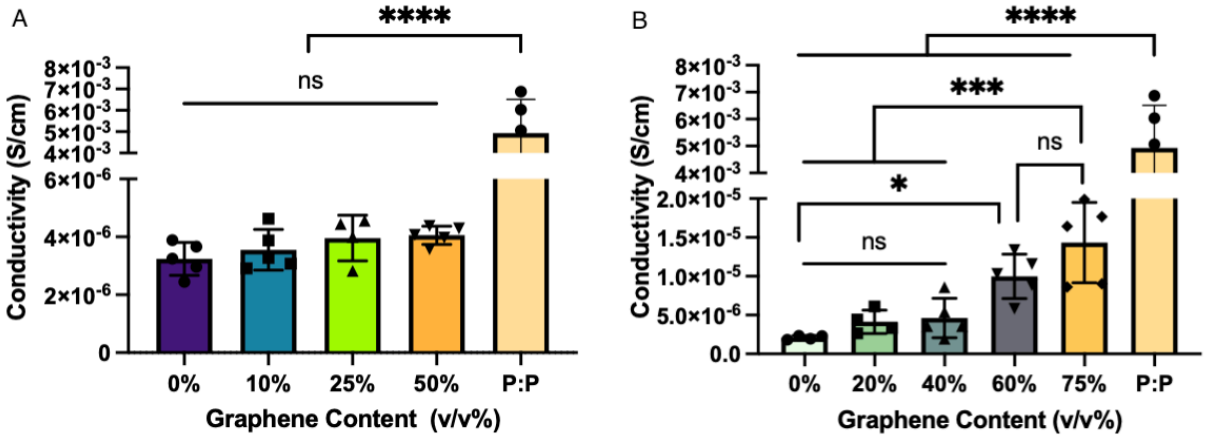


Bovine serum albumin in PBS

Alginate Lyase

BCA Assay

RESULTS



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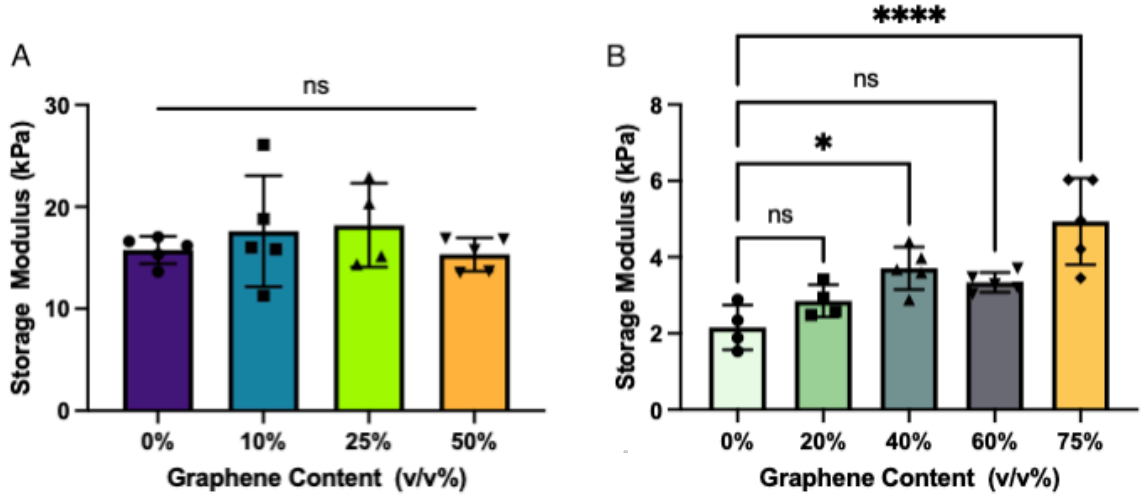


Figure 2. Mechanical characterization of graphene, RGD-modified Na alginate hydrogels. Storage modulus of hydrogels containing increasing graphene concentrations of 0 to 60 v/v% graphene **(A)** and 0 to 75 v/v% graphene **(B)**. Data are mean ∓ SD; n=4-5.

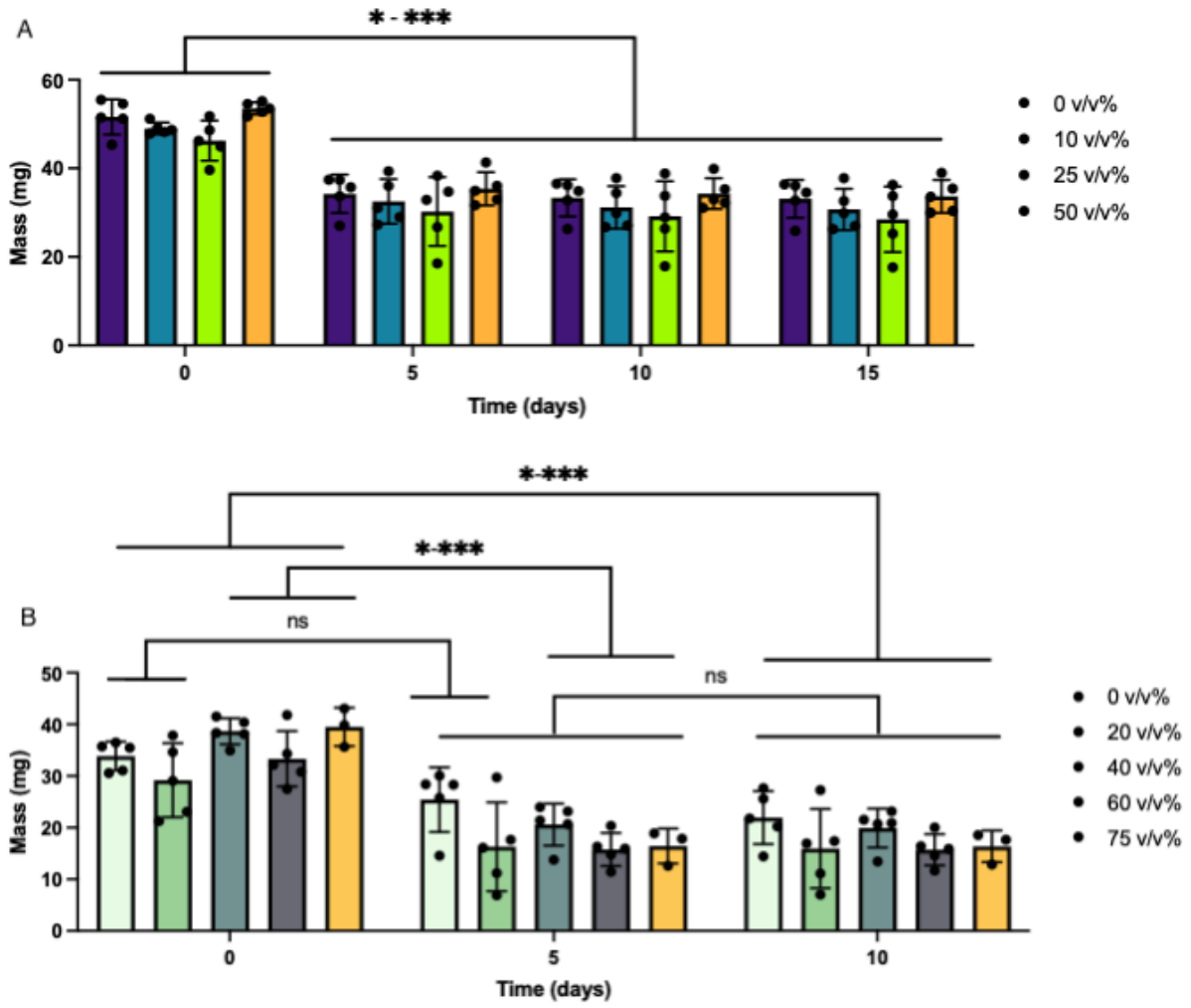


Figure 3. **Degradation properties of graphene, RGD-modified Na alginate hydrogels.** Degradation of hydrogels containing increasing graphene concentrations of 0 to 60 v/v% graphene over 15 days **(A)** and 0 to 75 v/v% graphene over 10 days **(B)**. Data are mean ∓ SD; n=4-5.

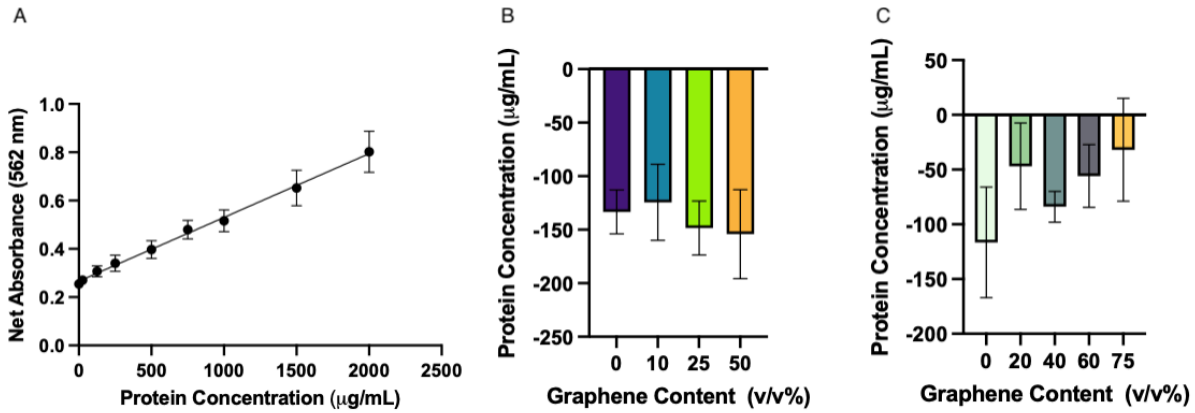


Figure 4. Graphene alginate hydrogel protein adsorption. (A) BCA Protein Assay standard curve read at 562 nm. **(B)** Protein concentration adsorbed into 0 to 60 v/v% graphene alginate hydrogels. **(C)** Protein concentration adsorbed into 0 to 75 v/v% graphene alginate hydrogels. Data are mean ∓ SD; n=5-6.

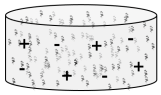
CONCLUSION

- The maximum concentration of graphene for gelation is 75 v/v%.
- An increase in graphene concentration can lead to an increase in conductivity.
- Storage modulus remains similar for most graphene concentration groups.
- Degradation rate of graphene alginate hydrogels declines from day 5 to day 15.
- These results can better serve future studies that aim to explain advantages of conductive materials for biological applications.

FUTURE WORK

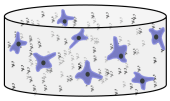
The effect of hydrogel conductivity on:

- Hydrogel surface charge.

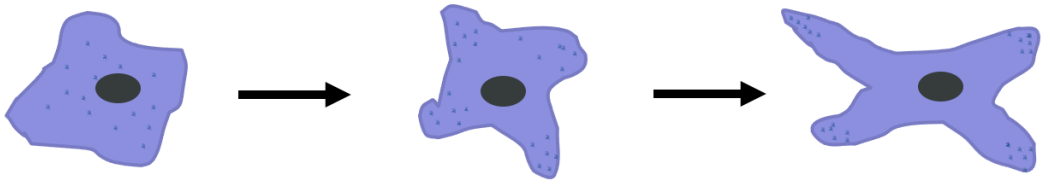


- PC12 cell adhesion.

- Cell viability and metabolic activity.



- Neurite extension and neuronal gene expression.



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